Highlighted Articles

Is El Niño really changing?
Geophysical Research Letters (4.253)

Planning for dynamic process: An assemblage-level surrogate strategy for species seasonal movement pathways
Aquatic Conservation: Marine and Freshwater Ecosystems (2.136)

Network approach to patterns in stratocumulus clouds
Proceedings of the National Academy of Sciences (9.423)

OSSE quantitative assessment of rapid-response prestorm ocean surveys to improve coupled tropical cyclone prediction
Journal of Geophysical Research: Oceans (2.939)

A comparative application of trophic ecosystem models to evaluate drivers of endangered Hawaiian monk seal populations
Marine Ecology Progress Series (2.54)

Long-term effects of bottom trawling on large sponges in the Gulf of Alaska
Continental Shelf Research (2.58)

Cross Line Office Articles

Lessons from the First Generation of Marine Ecological Forecast Products
Frontiers in Marine Science (n/a)

Using mineralogy and higher-level taxonomy as indicators of species sensitivity to pH: A case-study of Puget Sound
Elementa: Science of the Anthropocene (n/a)

Additional Articles

OAR Publications

Suitability of Laurentian Great Lakes for invasive species based on global species distribution models and local habitat

Ecosphere (2.287)

Near-surface salinity and temperature structure observed with dual-sensor drifters in the subtropical South Pacific

Journal of Geophysical Research: Oceans (2.939)

Regional trend analysis of surface ozone observations from monitoring networks in eastern North America, Europe and East Asia

ELEMENTA Science of the Anthropocene (n/a)

Modeling spring-summer phytoplankton bloom in Lake Michigan with and without riverine nutrient loading

Ocean Dynamics (2.23)

NMFS Publications

System Level Optimal Yield: Increased Value, Less Risk, Improved Stability, and Better Fisheries

Canadian Journal of Fisheries and Aquatic Sciences (2.47)

A method for predicting trawlability in the Gulf of Alaska with the use of calibrated, split-beam, echosounder backscatter

Fishery bulletin (1.135)

Space Oddity: The mission for spatial integration

Canadian Journal of Fisheries and Aquatic Sciences (2.845)

Reproductive life history of sablefish (*Anoplopoma fimbria*) from the U.S. Washington coast

PLoS ONE (2.806)

Suspect and non-target screening of organic contaminants and potential toxicants in highway runoff and fish tissue with high resolution time of flight mass spectrometry
Environmental Science: Processes & Impacts (2.171)

Description of a new species of Trichogypsiidae (Porifera, Calcarea) and first record of the genus in the Pacific Ocean
Zootaxa (0.994)

Monitoring riverine thermal regimes on stream networks: Insights into spatial sampling designs from the Snoqualmie River, WA
Ecological Indicators (3.88)

Fine-Scale Spatial and Temporal Variation in Fishing Mortality of Southern Flounder: Management Implications for a Dynamic Estuarine Fishery
North American Journal of Fisheries Management (1.201)

NOS Publications

Novel analyses of long-term data provide a scientific basis for chlorophyll-a thresholds in San Francisco Bay
Estuarine, Coastal and Shelf Science (2.057)

Other Reports, Book Chapters, and Internal Publications

The legacy of the 1992 Nicaragua tsunami
EOS (1.80)

Benthic habitat maps for the southeastern Puerto Rican shelf
NCCOS Technical Memorandum (n/a)

Highlighted Articles

Is El Niño really changing?
Geophysical Research Letters (4.253)
A. Capotondi, and P. Sardeshmukh (ESRL/PSD)

- In this study, the researchers used LIM to simulate a multi-millennial time series for the 20-yr periods before and after the 1970s shift.
- This allowed the researchers to take into account the full range of natural ENSO variations within each of these periods with high statistical confidence.
- The LIM technique also allowed the researchers to distinguish changes in the essential and predictable component of ENSO events from changes in the unpredictable, random component. This approach revealed a clear change in the predictable, but not the unpredictable, component of ENSO after the shift.

El Niño Southern Oscillation (ENSO) is an unusual warming and cooling of the tropical Pacific ocean that happens every few years, with far-reaching impacts worldwide. The strength, pattern, and frequency of ENSO events can change over several decades. One well-known example is the change that occurred in the late 1970s, after which ENSO events became stronger and less frequent than in previous decades. Because of its magnitude and widespread impact, this change has become known as an ENSO "regime shift". Previous research, though extensive, was inconclusive as to whether the shift happened by chance or because of changes in ENSO dynamics, including changes caused by global warming. In a new study to be published in Geophysical Research Letters, CIRES researchers at the ESRL Physical Sciences Division revisit this question using a sophisticated linear inverse modeling (LIM) technique, and conclude that the regime shift did not occur by chance but was due to a "real" change in the ENSO system.

ABSTRACT: El Niño Southern Oscillation (ENSO) is the leading mode of tropical Pacific climate variability, with global impacts. Understanding how the statistics of ENSO events may be changing in response to global warming is of great interest and importance for society. A clear detection of such signals in observations has however been obscured by large event-to-event differences and apparent "regime shifts" such as that of the late 1970s. In particular, despite extensive research, it is not clear to what extent the observed long-term changes are systemic or random. Here we show using a multi-component linear inverse modeling technique that statistically significant systemic changes have indeed occurred in ENSO dynamics since the late 1970s, and have affected the evolution of El Niño and La Niña events from their embryonic to fully mature stages.

Publication date: July 25, 2017
Available online: http://onlinelibrary.wiley.com/doi/10.1002/2017GL074515/full

Planning for dynamic process: An assemblage-level surrogate strategy for species seasonal movement pathways

Aquatic Conservation: Marine and Freshwater Ecosystems (2.136)
H. Welch (SWFSC/ERD) and J. McHenry

- This paper introduces a methodology to allow planners to explicitly plan for species seasonal movements during the protected area design process, and provide an example of how to do so in the Mid-Atlantic region.
- Results demonstrate that without explicitly planning for seasonal movements during reserve design, this important process is unlikely to be protected by happenstance, leading to changes in ecosystem function and biodiversity loss.

Seasonally mobile species are globally prevalent and often provide vital ecosystem functions and services along their seasonal movement pathways. However, due to the challenges of planning for features that are spatially and temporally variable, mobile species are rarely accounted for in conservation planning. To protect this dynamic process, planners need a temporally explicit surrogate for species seasonal movements pathways. Because reserves networks typically aim to represent the full spectrum of biodiversity, these surrogates also need to capture the assemblage-level organization of species in order to preserve the full range of seasonal movement pathways that occur within a given planning region. To this end, this study introduces a new assemblage-level surrogate strategy for species seasonal movements that preserves variation in biodiversity across the 12 months. Two monthly, assemblage-level attributes were integrated: discrete species assemblages and continuous assemblage suitability, thereby allowing planners to select complementary combinations of sites that achieve comprehensive assemblage coverage in each month. As a marine case-study, this strategy was applied to the U.S. Mid-Atlantic, and a gap analysis was used to evaluate the ability of the Mid-Atlantic's current spatial management scheme to accommodate species' seasonal movements. The results indicate that current protected areas in the Mid-Atlantic will be unable to meet even modest quantitative objectives for protecting seasonal movements, and priority conservation areas are identified for designing a reserve network that offers year-round protection. Planning for processes remains a significant gap in conservation planning, and this study seeks to address this gap by proposing a surrogate strategy that will aid the incorporation of a wide-spread dynamic process into reserve design. This strategy uses public,

predominantly global datasets that have terrestrial and marine counterparts, making it applicable to planning for species seasonal movements both on land and at sea.
Acceptance date: August 2017

Network approach to patterns in stratocumulus clouds
Proceedings of the National Academy of Sciences (9.423)
F. Glassmeier and **G. Feingold (OAR/ESRL)**

- Large parts of the subtropical oceans are covered by stratocumulus (Sc) cloud decks that self-organize into honeycomb-like hexagonal patterns. These clouds cool the planet by reflecting solar radiation.
- Inspired by similar patterns in biology and physics, Sc patterns were analyzed as dynamic cellular networks. This novel perspective allowed for the translation of detailed knowledge of cloud processes into a simple network model.
- This model offers for the first time a fundamental explanation of the structure and arrangement of Sc clouds and may contribute to improving their representation in climate models.

Stratocumulus clouds (Sc) have a significant impact on the amount of sunlight reflected back to space, with important implications for Earth's climate. Representing Sc and their radiative impact is one of the largest challenges for global climate models. Sc fields self-organize into cellular patterns and thus lend themselves to analysis and quantification in terms of natural cellular networks. Based on large-eddy simulations of Sc fields, we present a first analysis of the geometric structure and self-organization of Sc patterns from this network perspective. Our network analysis shows that the Sc pattern is scale-invariant as a consequence of entropy maximization that is known as Lewis's Law (scaling parameter: 0.16) and is largely independent of the Sc regime (cloud-free vs. cloudy cell centers). Cells are, on average, hexagonal with a neighbor number variance of about 2, and larger cells tend to be surrounded by smaller cells, as described by an Aboav–Weaire parameter of 0.9. The network structure is neither completely random nor characteristic of natural convection. Instead, it emerges from Sc-specific versions of cell division and cell merging that are shaped by cell

expansion. This is shown with a heuristic model of network dynamics that incorporates our physical understanding of cloud processes.
Publication date: September 13, 2017
Available online: www.pnas.org/content/early/2017/09/07/1706495114.full

OSSE quantitative assessment of rapid-response prestorm ocean surveys to improve coupled tropical cyclone prediction
Journal of Geophysical Research: Oceans (2.939)
L. K. Shay, V. H. Kourafalou, H. Kang, H. S. Kim, J. Dong, **R. Atlas, G. R. Halliwell, and M. Mehari (OAR AOML)**

- Researchers performed ocean observing system simulation experiments to evaluate impacts of ocean observations.
- Prestorm ocean profile surveys were found to reduce mesoscale errors and bias in ocean analyses used to initialize coupled TC prediction models.

Ocean fields that initialize coupled TC prediction models must accurately represent the dynamics of mesoscale features and the associated distribution of upper ocean temperature and salinity. They must also provide unbiased realizations of upper ocean heat content and stratification. Ocean Observing System Simulation Experiments (OSSEs) are performed for three storms: Isaac, 2012; Edouard, 2014; and Gonzalo, 2014. These OSSEs assess the impact of rapid-response prestorm ocean profile surveys on improving ocean model initialization. Two types of surveys are evaluated: airborne deployments of expendable profilers and deployments of in situ thermistor chains along lines intersecting predicted storm paths. Assimilation of the existing ocean observing system substantially constrains mesoscale structure in dynamical fields, primarily because of the four available altimeters. However, these observations only modestly constrain mesoscale structure and bias in upper ocean thermal fields. Adding rapid-response airborne surveys to these observing systems produces substantial additional correction in thermal fields, but minimal additional correction in dynamical fields. Without altimetry assimilation, rapid-response profiles produce large additional correction in both dynamical and thermal fields. Airborne CTDs sampling temperature and salinity over 1000 m versus XBTs sampling temperature over 400 m produce additional correction for dynamical fields, but not for upper ocean thermal fields.

Airborne surveys are generally more effective than thermistor chain deployments because they can sample a larger area at higher horizontal resolution and because the latter only measures temperature over the upper 100 m. Both airborne profile surveys and thermistor chain deployments effectively reduce upper ocean thermal biases.

Publication date: July 17, 2017

Available online: http://onlinelibrary.wiley.com/doi/10.1002/2017JC012760/full

A comparative application of trophic ecosystem models to evaluate drivers of endangered Hawaiian monk seal populations

Marine Ecology Progress Series (2.54)

M. Weijerman, S. Robinson, F. Parrish, J. Polovina, and C. Littnan (NMFS/PIFSC)

- Researchers found that the bottomfish fishery had a strong impact on the historical declining monk seal population trend.
- Factors other than changes in the environment and bottomfish played an additional role in the declining trend of the FFS breeding population.
- Results can help direct management and future research efforts in the recovery of the endangered monk seal population.

The Northwestern Hawaiian Islands share comparable biological community structures and have similar histories of fishing pressure, yet endangered monk seal subpopulations show different trends of decline between locations. Using trophic models, we compared the ecosystem structure and energy flows of two monk seal populations (on Laysan Island and the other at French Frigate Shoals (FFS) Atoll), each with varied rates of decline (1998-2015). Through simulated perturbations, we showed that the Laysan community had much higher productivity and was mainly forced by bottom-up processes, but prey and predator abundance also controlled the energy flow and community structure. The FFS ecosystem was less productive and strongly influenced by a change in primary productivity. Although the FFS system responded to a change in predator and prey abundance, the monk seals were more influenced by benthic bottomfish biomass than by a change in predator abundance. We clarified the role of external drivers (Pacific Decadal Oscillation [PDO] and benthic bottomfish fishery); while the PDO did show

correlation with monk seal population trends, the best models were driven by prey biomass as impacted by bottomfish removals. However, trophic dynamics were not sufficient to explain the observed decline in monk seal biomass. We suggest that other factors amplifying mortality played a role; for example, shark predation on monk seal pups at FFS. These results can help direct management or future research efforts in the recovery of endangered monk seal population.
Acceptance date: August 31, 2017

Long-term effects of bottom trawling on large sponges in the Gulf of Alaska
Continental Shelf Research (2.58)
P.W. Malecha and J. Heifetz (NMFS/AFSC)

- Persistent long-term effects of bottom trawling on large deepwater sponges are documented in this paper.
- In trawled areas, the density of sponges was lower and the rate of damage to sponges was higher.

Manipulative studies that characterize short-term effects of bottom trawls on seafloor habitats are numerous, but studies that examine long-term effects are rare. The long-term (13 years) effects of a single bottom trawl on large (>20 cm) erect sponges were investigated by revisiting the site of prior experimental trawling studies. In prior studies, large sponges were assessed immediately after trawling and 1 yr post-trawling. Thirteen years post-trawling, the average density of large sponges was 31.7% lower (range 1.5%-53.0%) and the incidence of sponge damage (torn, necrotic, missing tissue, prone) was 58.8% higher within strip transects in trawled versus untrawled reference areas. For all sponge species combined, the mean density of large sponges was 3.19 individuals 100 m-2 in trawled areas and 4.67 individuals 100 m-2 in reference areas. The most abundant sponge species in both trawled and reference areas was Rhabdocalyptus dawsoni. Mean density of this species differed greatly between trawled (1.57 individuals 100 m-2) and reference areas (2.91 individuals 100 m-2). Thirteen years after trawling, the mean percentage of damaged sponges on strip transects was 15.3% in trawled areas and 6.3% in reference areas. The rate of damage in trawled areas was less than that observed both immediately after trawling and 1 year later. The persistence of damage (lower sponge densities and higher rates of injury in trawled

areas) and the potential resultant changes to benthic communities where deepwater habitat-forming biota, such as large erect sponges, are present provide rationale for cautious management of the long term effects of bottom trawling.
Acceptance date: September 1, 2017
Available online:
http://www.sciencedirect.com/science/article/pii/S0278434316305003

CROSS LINE OFFICE ARTICLES

Lessons from the First Generation of Marine Ecological Forecast Products
Frontiers in Marine Science (n/a)
M. R. Payne, A. J. Hobday, B. R. MacKenzie, D. Tommasi (SWFSC), D. P. Dempsey, S. M. M. Fässler, **A. C. Haynie (AFSC)**, R. Ji, **G. L. (NESDIS)**, **P. D. Lynch (OST)**, D. Matei, A. K. Miesner, K. E. Mills, K. O. Strand and E. Villarino

- Skillful seasonal to decadal forecasts for marine systems are now a reality
- This paper reviews the state-of-the-art in the field of marine resource forecasting
- The availability of marine forecasts is likely to expand dramatically in the coming years and this paper offers criteria to determine where to invest efforts

Recent years have seen a rapid expansion in the ability of earth system models to describe and predict the physical state of the ocean. Skilful forecasts ranging from seasonal (3 months) to decadal (5–10 years) time scales are now a reality. With the advance of these forecasts of ocean physics, the first generation of marine ecological forecasts has started to emerge. Such forecasts are potentially of great value in the management of living marine resources and for all of those who are dependent on the ocean for both nutrition and their livelihood; however, this is still a field in its infancy. We review the state of the art in this emerging field and identify the lessons that can be learnt and carried forward from these pioneering efforts. The majority of this first wave of products are forecasts of spatial distributions, possibly reflecting the inherent suitability of this response variable to the task of forecasting. Promising developments are also seen in forecasting fish-stock recruitment where, despite well-recognized challenges in understanding and predicting this response, new process knowledge and model approaches that could form a basis for forecasting are becoming available. Forecasts of phenology and coral-bleaching events are also being applied to monitoring and industry decisions. Moving marine ecological forecasting forward will require striking a

balance between what is feasible and what is useful. We propose here a set of criteria to quickly identify "low-hanging fruit" that can potentially be predicted; however, ensuring the usefulness of forecast products also requires close collaboration with actively engaged end-users. Realizing the full potential of marine ecological forecasting will require bridging the gaps between marine ecology and climatology on the one-hand, and between science and end-users on the other. Nevertheless, the successes seen thus far and the potential to develop further products suggest that the field of marine ecological forecasting can be expected to flourish in the coming years.
Acceptance date: 25 August 2017

Using mineralogy and higher-level taxonomy as indicators of species sensitivity to pH: A case-study of Puget Sound
Elementa: Science of the Anthropocene (n/a)
D. S. Busch (OAR/OAP) and **P. McElhaney (NMFS/NWFSC)**

- By looking at a broad array of species, the vulnerability of non-calcifying marine life to ocean acidification is illuminated.
- The findings emphasize the value of detailed information on species performance under elevated carbon chemistry conditions for building the understanding we need to guide management decisions.
- The authors also highlight the need to use caution in making broad generalizations of what type of marine life will be impacted by ocean acidification.

Information on ecosystem sensitivity to global change can help guide management decisions. Here, we characterize the sensitivity of the Puget Sound ecosystem to ocean acidification by estimating, at a number of taxonomic levels, the direct sensitivity of its species. We compare sensitivity estimates based on species mineralogy and on published literature from laboratory experiments and field studies. We generated information on the former by building a database of species in Puget Sound with mineralogy estimates for all CaCO3-forming species. For the latter, we relied on a recently developed database and meta-analysis on temperate species responses to increased CO2. In general, species sensitivity estimates based on the published literature suggest that calcifying species are more sensitive to increased CO2 than non-calcifying species. However, this generalization is incomplete, as non-calcifying species also show direct sensitivity to high CO2

conditions. We did not find a strong link between mineral solubility and the sensitivity of species survival to changes in carbonate chemistry, suggesting that, at coarse scales, mineralogy plays a lesser role to other physiological sensitivities. Summarizing species sensitivity at the family level resulted in higher sensitivity scalar scores than at the class level, suggesting that grouping results at the class level may overestimate species sensitivity. This result raises caution about the use of broad generalizations on species response to ocean acidification, particularly when developing summary information for specific locations. While we have much to learn about species response to ocean acidification and how to generalize ecosystem response, this study on Puget Sound suggests that detailed information on species performance under elevated carbon dioxide conditions, summarized at the lowest taxonomic level possible, is more valuable than information on species mineralogy.

Publication date: September 12, 2017

Available online: https://www.elementascience.org/articles/10.1525/elementa.245/

ADDITIONAL ARTICLES

OAR Publications

Suitability of Laurentian Great Lakes for invasive species based on global species distribution models and local habitat

Ecosphere (2.287)

A.M. Kramer, G. Annis, M. E. Wittmann, W. L. Chadderton, **E. S. Rutherford (OAR GLERL)**, D. M. Lodge, L. Mason, **D. Beletsky (OAR/OARO)**, C. Riseng, J. M. Drake

- Using new methods to improve prediction, management, and prevention of new aquatic species invasions.
- Our approach illustrates the strength of combining multiple sources of data, while reiterating the need for increased measurement of freshwater habitat at high spatial resolutions to improve the ability to predict potential invasive species.

Efficient management and prevention of species invasions requires accurate prediction of where species of concern can arrive and persist. Species distribution models provide one way to identify potentially suitable habitat by developing the relationship between climate variables and species occurrence data. However, these models when applied to freshwater invasions are complicated by two factors.

The first is that the range expansions that typically occur as part of the invasion process violate standard species distribution model assumptions of data stationarity. Second, predicting potential range of freshwater aquatic species is complicated by the reliance on terrestrial climate measurements to develop occurrence relationships for species that occur in aquatic environments. To overcome these obstacles, we combined a recently developed algorithm for species distribution modeling—range bagging—with newly available aquatic habitat-specific information from the North American Great Lakes region to predict suitable habitat for three potential invasive species: golden mussel, killer shrimp, and northern snakehead. Range bagging may more accurately predict relative suitability than other methods because it focuses on the limits of the species environmental tolerances rather than central tendency or "typical" cases. Overlaying the species distribution model output with aquatic habitat-specific data then allowed for more specific predictions of areas with high suitability. Our results indicate there is suitable habitat for northern snakehead in the Great Lakes, particularly shallow coastal habitats in the lower four Great Lakes where literature suggests they will favor areas of wetland and submerged aquatic vegetation. These coastal areas also offer the highest suitability for golden mussel, but our models suggest they are marginal habitats. Globally, the Great Lakes provide the closest match to the currently invaded range of killer shrimp, but they appear to pose an intermediate risk to the region. Range bagging provided reliable predictions when assessed either by a standard test set or by tests for spatial transferability, with golden mussel being the most difficult to accurately predict. Our approach illustrates the strength of combining multiple sources of data, while reiterating the need for increased measurement of freshwater habitat at high spatial resolutions to improve the ability to predict potential invasive species.
Publication Date: July 14, 2017
Available Online: http://onlinelibrary.wiley.com/doi/10.1002/ecs2.1883/full

Near-surface salinity and temperature structure observed with dual-sensor drifters in the subtropical South Pacific
Journal of Geophysical Research: Oceans (2.939)
S. Dong, D. Volkov, G. Goni, R. Lumpkin, and G. R. Foltz (OAR/AOML)

- Regional salinity differences between 0.2 and 5 m depths are small, and Aquarius-Argo differences are not due to surface stratification.
- Winds strongly modulate the surface stratification under rainfall and intense warming conditions.
- A diurnal cycle of salinity is observed at 0.2 m dominated by events with winds less than 2 m/s.

Three surface drifters equipped with temperature and salinity sensors at 0.2 and 5 m depths were deployed in April/May 2015 in the subtropical South Pacific with the objective of measuring near-surface salinity differences seen by satellite and in situ sensors and examining the causes of these differences. Measurements from these drifters indicate that water at a depth of 0.2 m is about 0.013 psu fresher than at 5 m and about 0.0248C warmer. Events with large temperature and salinity differences between the two depths are caused by anomalies in surface freshwater and heat fluxes, modulated by wind. While surface freshening and cooling occurs during rainfall events, surface salinification is generally observed under weak wind conditions (4 m/s). Further examination of the drifter measurements demonstrates that (i) the amount of surface freshening and strength of the vertical salinity gradient heavily depend on wind speed during rain events, (ii) salinity differences between 0.2 and 5 m are positively correlated with the corresponding temperature differences for cases with surface salinification, and (iii) temperature exhibits a diurnal cycle at both depths, whereas the diurnal cycle of salinity is observed only at 0.2 m when the wind speed is less than 6 m/s. The amplitudes of the diurnal cycles of temperature at both depths decrease with increasing wind speed. The mean diurnal cycle of surface salinity is dominated by events with winds less than 2 m/s.
Publication date: July 27, 2017
Available online: http://onlinelibrary.wiley.com/doi/10.1002/2017JC012894/full

Regional trend analysis of surface ozone observations from monitoring networks in eastern North America, Europe and East Asia
ELEMENTA Science of the Anthropocene (n/a)
K.L. Chang, I. Petropavlovskikh, O.R. Cooper, M.G. Schultz, T. Wang (OAR/ESRL GMD)

- In eastern North America surface ozone has decreased strongly in summertime.
- The regression result of the ozone trends in Europe shows that significant decreases of daytime average and summertime mean of DMA8 are only detecTable in rural sites.
- All the metrics indicate that surface ozone increased over East Asia, with statistically significant trends of 0.40 and 0.37 ppb yr–1 estimated for summertime mean of daytime average and DMA8, respectively.

This paper provides a trend analysis of summertime surface ozone in eastern North America, Europe and East Asia for several metrics during 2000–2014. Our approach assumes that there is an overall and averaged seasonal cycle and an interannual trend in the study region. The expected achievement in this approach

lies in the combination and adjustment of the deviations from each station to the overall regional trend. All of the components in the GAMM are not new techniques, however, this sophisticated incorporation with a focus on overall variations of multiple time series for large and irregular spatial datasets has not been accounted as a whole in previous studies. All of our approaches in this paper are easy to implement under moderate computational costs, and are suitable for application to the TOAR dataset.
Publication date: September 7, 2017
Available online: https://www.elementascience.org/articles/10.1525/elementa.243/

Modeling spring-summer phytoplankton bloom in Lake Michigan with and without riverine nutrient loading
Ocean Dynamics (2.23)
L. Luo, D. Wang, **J. Wang, T. Hunter, and H. Vanderploeg (OAR/GLERL)**

- Two phytoplankton blooms in Lake Michigan in 1988 were simulated by a coupled physical-biological model, and model results, with and without riverine nutrient input, were compared with remote sensing data.
- The model performed well when riverine input was included.

There were two phytoplankton blooms captured by remote sensing in Lake Michigan in 1998, one from March to May, and one during June. In this paper, those phytoplankton blooms were simulated by a coupled physical–biological model, driven by observed meteorological forcing in 1998. The model reasonably reproduced the lake currents. The biological model results, with and without riverine nutrient loading, were compared with the remote sensing data. A 3-month-long donut-like phytoplankton bloom that appeared in southern Lake Michigan was reasonably well simulated only when riverine input was included, indicating the importance of riverine nutrient input for supporting the growth of phytoplankton in Lake Michigan. The model with riverine input also captured a second event-driven phytoplankton bloom during June with weaker magnitude that occurred in mid-south Lake Michigan, which lasted for about 20 days. The major reason for the weaker bloom in June was that vertical mixing in the hydrodynamic model was too weak (leading to a mixed-layer depth of 20 m) to bring the bottom nutrient-rich water up to the epilimnion. High chlorophyll concentration that persisted in Green Bay for almost a year was simulated with less intensity.
Publication date: September 7, 2017
Available online:
https://link.springer.com/article/10.1007/s10236-017-1092-x?wt_mc=Internal.Event.1.SEM.ArticleAuthorOnlineFirst

NMFS Publications

System Level Optimal Yield: Increased Value, Less Risk, Improved Stability, and Better Fisheries

Canadian Journal of Fisheries and Aquatic Sciences (2.47)

J.S. Link (NMFS)

- Provides a primer on systems theory in the context of optimal yield and the overall discipline of fisheries (both science and management)
- Makes the case, via summaries from theory, simulations, empirical observations, and 2 cases studies, for the benefits of adopting such an approach over business as usual
- Provides tangible, feasible, pragmatic suggestions of how this might further benefit fisheries management via specific proposals for ecosystem-level reference points

The discipline and practice of fisheries science and management have had an useful, successful, and interesting history. The discipline has developed over the past century and a half into a very reductionist, highly quantitative, socially impactful endeavor. Yet given our collective successes in this field, some notable challenges remain. To address these challenges, many have proposed ecosystem-based fisheries management that takes a more systematic approach to the management of these living marine resources. Here I describe systems theory and associated constructs underlying system dynamics; elucidate how aggregate properties of systems can and have been used; contextualize these aggregate features relative to optimal yield; and note how this approach can produce useful estimates, and outcomes, for fisheries management. I explore two contrasting examples where this approach has and has not been considered, highlighting the benefits of applying such an approach. I conclude by discussing ways in which we might move forward with a portfolio approach for both the discipline and practice of fisheries science and management.

Publication date: September 7, 2017

Available online:
http://www.nrcresearchpress.com/doi/abs/10.1139/cjfas-2017-0250#.WcUbHGtSzIV

A method for predicting trawlability in the Gulf of Alaska with the use of calibrated, split-beam, echosounder backscatter
Fishery bulletin (1.135)
P. G. von Szalay (NMFS/AFSC) and **D. A. Somerton (NMFS/AFSC)**

- This paper describe methods to ultimately reduce known bias of abundance estimates of many rockfishes and flatfishes that result from the current practice of extrapolating fish densities observed in trawlable areas to untrawlable areas.

We examined the feasibility of distinguishing trawlable from untrawlable bottom using acoustic backscatter data from a calibrated single-beam echosounder to better define and map continental shelf areas of the Gulf of Alaska (GOA) that are too rough and rocky to be sampled by the National Marine Fisheries Service's biennial bottom trawl groundfish survey. Bottom classification algorithms were applied to backscatter data collected from areas of known trawlability to provide 9 metrics of bottom type from small sections of bottom (~50 records within a 15-min trawl tow). Prediction models, based on both generalized additive models (GAMs) and generalized linear models (GLMs), were developed to relate the bottom type metrics to the known state of trawlability. The models were then tested to judge their performance on new data by using 33% cross validation. Although the best GAM had a higher correct prediction rate (82.4%) than the best GLM (76.9%), under cross validation both models had nearly the same correct prediction rate (75.0%). This result is a sufficiently high prediction rate to allow the development of better trawlability maps by applying the model to data collected along acoustic track lines during the GOA bottom trawl surveys.
Publication date: August 16, 2017
Available online: http://fishbull.noaa.gov/1154/szalay.pdf

Space Oddity: The mission for spatial integration
Canadian Journal of Fisheries and Aquatic Sciences (2.845)
A. M. Berger (NMFS/NWFSC), **D. R. Goethel (NMFS/SEFSC)**, **P. D. Lynch (NMFS/OST)**, T. Quinn II, S. Mormede, J. McKenzie, and A. Dunn

- This study investigates how spatial models have been incorporated into the management process in the past since it is known that spatial complexity is

present in many aquatic species, and this can influence analyses that do not account for such complexity.

- Even though there were limited examples of spatial assessment models the researchers found that incorporating spatial complexity and associated drivers into the current single species assessment and management paradigm is an important step toward ecosystem-based fisheries management (EBFM).

Fishery management decisions are commonly guided by stock assessment models that aggregate outputs across the spatial domain of the species. With refined understanding of spatial population structures, scientists have begun to address how spatiotemporal mismatches among the scale of ecological processes, data collection programs, and stock assessment methods (or assumptions) influence the reliability and, ultimately, appropriateness of regional fishery management (e.g., assigning regional quotas). Development and evaluation of spatial modeling techniques to improve fisheries assessment and management have increased rapidly in recent years. We overview the historical context of spatial models in fisheries science, highlight recent advances in spatial modeling, and discuss how spatial models have been incorporated into the management process. Despite limited examples where spatial assessment models are used as the basis for management advice, continued investment in fine-scale data collection and associated spatial analyses will improve integration of spatial dynamics and ecosystem-level interactions in stock assessment. In the near future, spatiotemporal fisheries management advice will increasingly rely on fine-scale outputs from spatial analyses.

Publication date: June 14, 2017

Available online:

http://www.nrcresearchpress.com/doi/pdf/10.1139/cjfas-2017-0150

*Reproductive life history of sablefish (*Anoplopoma fimbria*) from the U.S. Washington coast*

PLoS ONE (2.806)

M. A. Middleton, C. Jensen, A. Jasonowicz, **J. Maria Guzman**, **A. Luckenbach**, **K. C. Massee**, and **F. W. Goetz**, **P. Swanson (NMFS/NWFSC)**

- This study characterized the complete reproductive cycle of sablefish off the Washington coast.
- Provides detailed reproductive staging criteria for female (ovarian) and male (testicular) development in sablefish and potential indicators of maturation.
- Our results suggest that sablefish along the Washington coast initiate their reproductive cycle in March/April and spawn primarily in January/February.

Sablefish (*Anoplopoma fimbria*) is a marine groundfish that supports valuable fisheries in the North Pacific Ocean and holds promise for marine aquaculture. Limited information is available, however, about its reproductive biology. This study aimed to characterize the complete reproductive cycle, including seasonal changes in gonadal development (macroscopic and histological), plasma sex steroid levels (17¿-estradiol -E2-, and 11-ketotestosterone -11KT-), gonadosomatic and hepatosomatic indices (GSI, and HSI), and condition factor (K) of female and male sablefish captured off the Washington coast. Adult fish (209 females, 159 males) were caught by longline monthly from August 2012 to August 2013. Early signs of recruitment of ovarian follicles into secondary growth, indicated by oocytes containing small yolk granules and cortical alveoli, were first observed in March. Oogenesis progressed during spring and summer, and fully vitellogenic follicles were first observed in July. Vitellogenic growth was correlated with increases in plasma E2, GSI, HSI and K. Periovulatory females, indicated by fully-grown oocytes with migrating germinal vesicles and hydrated oocytes, were found from November to February. At this stage, plasma E2 and GSI reached maximal levels. In males, proliferating cysts containing spermatocytes were first observed in April. Testicular development proceeded during spring and summer, a period during which all types of male germ cells were found. The first clusters of spermatozoa appeared in July, concomitant with a 5.2-fold increase in GSI. Spermiating males were observed from November to April; at this time, spermatids were absent or greatly reduced, and testis lobules were filled with spermatozoa. The highest levels of plasma 11KT were found in males at this stage. Postspawning ovaries and testes, and basal steroids levels were found in fish captured from February to April. These results suggest that sablefish in coastal Washington initiate their reproductive cycle in March/April and spawn primarily in January/February.

Publication Date: September 8, 2017

Available Online:
http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0184413

Suspect and non-target screening of organic contaminants and potential toxicants in highway runoff and fish tissue with high resolution time of flight mass spectrometry

Environmental Science: Processes & Impacts (2.171)

B. Du, J. Lofton, K. Peter, A. Gipe, C. A. James, J. McIntyre, **N. L. Scholz (NMFS/NWFSC)**, J. E. Baker, and E. Kolodziej

- This work represents the beginning of a collaboration between the Center and the University of Washington, Department of Civil Engineering.
- The goal is to chemically fractionate urban stormwater runoff and identify which contaminants are specifically toxic to salmon and other aquatic species.
- The team used state-of-the-art spectrometry methods to show that urban runoff contains thousands of unique chemicals (by absolute mass), the large majority of which have never been identified or toxicologically characterized.

Untreated urban stormwater runoff contributes to poor water quality in receiving waters. To protect ecosystem and human health, identifying toxicants and other important bioactive molecules in complex contaminant mixtures is a challenging, yet important, analytical task. To characterize urban stormwater runoff, we developed analytical methods using liquid chromatography high resolution quadrupole time of flight mass spectrometry (LC-QTOF-MS/MS) to detect toxicants and organic contaminants in highway runoff and in runoff-exposed fish (adult coho salmon, *Oncorhynchus kisutch*). Processing of paired water and tissue samples facilitated contaminant prioritization and aided investigation of chemical bioavailability and uptake processes. Simple, minimal processing effort solid phase extraction (SPE) and elution procedures were optimized for water samples, and selective pressurized liquid extraction (SPLE) procedures were optimized for fish tissues. Extraction methods were compared by detection of non-target features and target compounds (e.g., quantity and peak area), while minimizing matrix interferences. To integrate biological knowledge and site ecotoxicological data into

contaminant screening, suspect screening techniques utilized in-house and commercial databases to focus on potential high risk detections for subsequent confirmation with MS/MS characterization. Presumptive annotations were also screened with an in-house linear regression ($\log K_{ow}$ vs. retention time) to exclude isobaric compounds. Ethoprophos, prometon, DEET, caffeine, cotinine, and acetanilide were confirmed in highway runoff by reference standard comparison. Acetanilide was also detected in the runoff-exposed fish gill and liver samples, along with large numbers of unidentified detections of stormwater-derived compounds. Further characterization of highway runoff and fish tissues (14 and 19 compounds, respectively with tentative identification by MS/MS data) suggests that many novel or poorly characterized organic contaminants and possible toxicants exist in urban stormwater runoff and exposed biota.
Publication date: August 9, 2017
Available online:
http://pubs.rsc.org/en/content/articlelanding/2017/em/c7em00243b#!divAbstract

Description of a new species of Trichogypsiidae (Porifera, Calcarea) and first record of the genus in the Pacific Ocean
Zootaxa (0.994)
H. Lehnert and **R. P. Stone (NMFS)**

- A new species of sponge are described plus new geographical range extensions.
- A comprehensive review of the rare group of sponges is provided world-wide.
- Our results indicate that sponge species richness is relatively low compared to neighboring regions.

A new species of Trichogypsiidae is described and compared to its congeners. Trichogypsia alaskensis n. sp. represents the fifth species of the family and with this record all three genera of the family are now represented in the North Pacific Ocean. Calcarea are rare in the Gulf of Alaska but with this new record the number of confirmed species rises from two to three. The new species has larger diactines of a broader size range and with a different pattern of spination than all congeners.
Publication date: August 29, 2017

Monitoring riverine thermal regimes on stream networks: Insights into spatial sampling designs from the Snoqualmie River, WA
Ecological Indicators (3.88)
A. Marsha, A. Steel, **A. H. Fullerton (NMFS/NWFSC)**, C.N. Sowder

- The study found more sites increased predictive precision, but not necessarily predictive accuracy.
- Mean temperatures were easier to model than maximums, minimums, or variability.
- Winter data were less variable and therefore easier to model than summer data.
- Nearby sites with discordant thermal regimes have potential to be highly influential.

Understanding, predicting, and managing the spatiotemporal complexity of stream thermal regimes requires monitoring strategies designed specifically to make inference about spatiotemporal variability on the whole stream network. Moreover, monitoring can be tailored to capture particular facets of this complex thermal landscape that may be important indicators for species and life stages of management concern. We applied spatial stream network models (SSNMs) to an empirical dataset of water temperature from the Snoqualmie River watershed, WA, and use results to provide guidance with respect to necessary sample size, location of new sites, and selection of a modeling approach. As expected, increasing the number of monitoring stations improved both predictive precision and the ability to estimate covariates of stream temperature; however, even relatively small numbers of monitoring stations, n= 20, did an adequate job when well-distributed and when used to build models with only a few covariates. In general, winter data were easier to model and, across seasons, mean temperatures were easier to model than summer maximums, winter minimums, or variance. Adding new sites was advantageous but we did not observe major differences in model performance for particular new site locations. Adding sites from parts of the river network with thermal regimes which differed from the rest of the network, and which were therefore highly influential, improved nearby predictions but reduced model-estimated precision of predictions in the rest of the network. Lastly, using

models which accounted for the network-based spatial correlation between observations made it much more likely that estimated prediction confidence intervals covered the true parameter; the exact form of the spatial correlation made little difference. By incorporating spatial structure between observations, SSNMs are particularly valuable for accurate estimation of prediction uncertainty at unmeasured locations. Based on our results, we make the following suggestions for designing water temperature monitoring arrays: (1) make use of pilot data when possible; (2) maintain a distribution of monitors across the stream network (i.e., over space and across the full range of covariates); (3) maintain multiple spatial clusters for more accurately estimating correlation of nearby sites; (4) if sites are to be added, prioritize capturing a range of covariates over adding new tributaries; (5) maintain a sensor array in winter; and (6) expect reduced accuracy and precision when predicting metrics other than means.
Acceptance date: 8/31/2017
Available online:
http://www.sciencedirect.com/science/article/pii/S1470160X17305186

Fine-Scale Spatial and Temporal Variation in Fishing Mortality of Southern Flounder: Management Implications for a Dynamic Estuarine Fishery
North American Journal of Fisheries Management (1.201)
F.S. Scharf, **J.K.Craig (NMFS SEFSC), and W.E. Smith (NMFS NCDMF)**

- Researchers conducted a paired tag return experiment in spatially distinct estuarine fisheries during two consecutive years to examine temporal and spatial variation in harvest of a commercially exploited flatfish, the Southern Flounder Paralichthys lethostigma, in North Carolina.
- Researchers document spatial and temporal variation in fishing mortality between distinct estuarine ecosystems in North Carolina in comparison to those generated by the state wide stock assessment.

Fish demography and the behavior of fishing fleets can vary across fine spatial and temporal scales, generating dynamic patterns of harvest that can impact both fishery yield and the conservation of stock biomass. We conducted a paired tag return experiment in spatially distinct estuarine fisheries during two consecutive years to examine temporal and spatial variation in harvest of a commercially

exploited flatfish, the Southern Flounder Paralichthys lethostigma, in North Carolina. Monthly rates of instantaneous fishing mortality (F) varied across the fishing season in different ways, thus generating differences in total F between the two systems despite the fact that the fishery was concentrated in the warmer months and was dominated by the same gear in both systems. Recent patterns in fishing effort among gears and water bodies throughout the state illustrated seasonal and spatial variation that was produced mainly by gear type. Although current regulations in the Southern Flounder fishery recognize the existence of spatial differences in fishery selectivity and seasonality across North Carolina, fleet behavior has shown rapid and dynamic changes over time. When combined with recently documented fine-scale spatial variation in life history traits, these spatial patterns of effort and harvest that change in response to regulatory measures and socioeconomic drivers can potentially influence—in ways that are difficult to predict—the ability of managers to achieve harvest and conservation goals.
Publication date: August 23, 2017

NOS Publications

Novel analyses of long-term data provide a scientific basis for chlorophyll-a thresholds in San Francisco Bay
Estuarine, Coastal and Shelf Science (2.057)
M. Sutula, R. Kudela, J.D. Hagy III, L.W. Harding Jr., D. Senn, J.E. **Cloern, S. Bricker (NOS/NCCOS)**, G.M. Berg, and M. Beck

- Researchers analyzed data for DO, phytoplankton species composition, chl-a, and algal toxins to derive quantitative relationships between three indicators (HAB abundance, toxin concentrations, DO) and chl-a.
- Conditional probability analysis (CPA) showed chl-a of 13 mg m−3 as a "protective" threshold below which probabilities for exceeding alert levels for HAB abundance and toxins were reduced.
- Researchers developed a transferrable approach to derive *chl*-athresholds protective against eutrophication.

San Francisco Bay (SFB), USA, is highly enriched in nitrogen and phosphorus, but has been resistant to the classic symptoms of eutrophication associated with over-production of phytoplankton. Observations in recent years suggest that this

resistance may be weakening, shown by: significant increases of chlorophyll-a (chl-a) and decreases of dissolved oxygen (DO), common occurrences of phytoplankton taxa that can form Harmful Algal Blooms (HAB), and algal toxins in water and mussels reaching levels of concern. As a result, managers now ask: what levels of chl-a in SFB constitute tipping points of phytoplankton biomass beyond which water quality will become degraded, requiring significant nutrient reductions to avoid impairments? We analyzed data for DO, phytoplankton species composition, chl-a, and algal toxins to derive quantitative relationships between three indicators (HAB abundance, toxin concentrations, DO) and chl-a. Quantile regressions relating HAB abundance and DO to chl-a were significant, indicating SFB is at increased risk of adverse HAB and low DO levels if chl-a continues to increase. Conditional probability analysis (CPA) showed chl-a of 13 mg m−3 as a "protective" threshold below which probabilities for exceeding alert levels for HAB abundance and toxins were reduced. This threshold was similar to chl-a of 13–16 mg m−3 that would meet a SFB-wide 80% saturation Water Quality Criterion (WQC) for DO. Higher "at risk" chl-a thresholds from 25 to 40 mg m−3 corresponded to 0.5 probability of exceeding alert levels for HAB abundance, and for DO below a WQC of 5.0 mg L−1 designated for lower South Bay (LSB) and South Bay (SB). We submit these thresholds as a basis to assess eutrophication status of SFB and to inform nutrient management actions. This approach is transferrable to other estuaries to derive chl-athresholds protective against eutrophication.

Acceptance date: July 10, 2017
Available online:
http://www.sciencedirect.com/science/article/pii/S0272771417307205

OTHER REPORTS, BOOK CHAPTERS, AND INTERNAL PUBLICATIONS

The legacy of the 1992 Nicaragua tsunami
EOS (1.80)
N. Arcos (NESDIS/NCEI), P. K. Dunbar (NESDIS/NCEI), K. Stroker (NESDIS/NCEI), L. Kong (NWS/ITIC)

- This unusual earthquake resulted in the first coordinated collaboration among international tsunami scientists.

- Post-tsunami surveys are now coordinated, interdisciplinary, international efforts. In some cases, the affected country may even request IOC and ITIC assist coordination efforts.
- Better hazard management stems from coordinated scientific focus. This event in Nicaragua demonstrate this and serves as an enduring example of how collaboration yields information that may ultimately save lives.

On the night of 1 September 1992, a deadly tsunami struck the Pacific coast of Nicaragua with little or no warning, triggered by a nearby earthquake. Early newspaper reports indicated waves almost 15 meters high swept away houses, boats, vehicles, and anything in their path. The earthquake and tsunami left at least 170 people dead, approximately 500 injured, and more than 13,500 homeless. The tsunami caused most of the damage. Following the earthquake, the National Oceanic and Atmospheric Administration (NOAA) Pacific Tsunami Warning Center (PTWC) did not issue a tsunami warning. That's because the earthquake's initial surface wave magnitude (Ms) was only 6.8 and lower than their warning threshold. The source was only about 100 kilometers away and many coastal residents didn't feel the earthquake. The unusual earthquake source characteristics and growing interest in tsunamis in the United States led to the organization of the first International Tsunami Survey Team (ITST) to document the tsunami's effects. For the 25th anniversary of this event, we interviewed several Japanese and U.S. scientists involved with assessing the tsunami that followed this earthquake. From their accounts, we learned that ascertaining why coastal residents didn't feel the earthquake greatly improved the ways scientists study tsunami generation and coordinate post-tsunami surveys today.
Publication date: August 27, 2017
Available online:
https://eos.org/features/the-legacy-of-the-1992-nicaragua-tsunami

Benthic habitat maps for the southeastern Puerto Rican shelf
NCCOS Technical Memorandum (n/a)
B. Costa, L. Kracker, T. Battista, W. Sautter, A. Mabrouk, K. Edwards, C. Taylor, E. Ebert (NOS/NCCOS)

- Approximately 593 sq km of seafloor was characterized on the Southeastern Puerto Rican Insular Shelf. 'Aggregate Reef colonized with Live Coral' was the most abundant habitat type, comprising 34.3 percent (203.3 sq km) of the area.

- Live Hard Coral occurred at 52 percent (524/1005) of the sites surveyed, occurring more frequently in the western half and near the shelf edge on the Insular Shelf.
- Understanding the current, spatial distributions of mesophotic coral reef habitats is needed to evaluate zoning scenarios, minimize user conflicts, and prevent environmental degradation in the U.S. Caribbean.

Mesophotic coral reef ecosystems (MCEs) within the Caribbean provide ecological and economic benefits related to tourism, fisheries, and shoreline protection. They support a variety of marine organisms, including endangered coral and fish species. Recently, attention has been directed at documenting MCEs and collecting information on their spatial distribution. This three-year project funded by NOAA's Coral Reef Conservation Program (CRCP) has resulted in benthic habitat maps for uncharacterized areas between 30–100 m in depth on the southeastern Puerto Rican (Insular) Shelf. These new habitat maps provide information to help guide the monitoring and management of important mesophotic coral reef habitats, fisheries species spawning aggregation sites, and marine protected areas in the U.S. Virgin Islands and broader jurisdiction. It characterizes the distribution, and type of habitats of the Insular Shelf and provides a baseline to develop monitoring plans and evaluate changes in these systems over time.

Expected publication date: January 2018